# Environmental Epidemiology: An Introduction to its Merits and Problems

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*During the course of this century the science of epidemiology has expanded its interest from only infectious diseases to include a wide variety of diseases and health events. It has become more of a systematic methodology which can be used for the description and the analysis of diverse health events. The basic assumption of epidemiologic research is that diseases do not occur randomly, but in patterns which reflect the underlying causes. By studying the patterns etiologic factors can be discovered. Recently, Environmental Epidemiology has been emerging as a new subspecialty. In 1989 the newly founded International Society for Environmental Epidemiology held its first Annual Meeting; its second meeting was held in August 1990 in Berkeley, California*

This paper will first illustrate the usefulness of epidemiology in environmental research and then discuss some of the problems of applying epidemiologic methods to environmental issues.

Environmental epidemiology concerns itself with very diverse problems. They include ionizing radiation, electromagnetic radiation, hazard waste sites, pesticides and other chemicals, asbestos, heavy metals, radon, fluoride in water, aflatoxins in food, and many others.

Many of today's environmental concerns first came to public attention the result of reports of disease clusters, or so called outbreaks. Well-documented examples are leukemia in Hiroshima and Nagasaki, sterility among farm workers who handled DBCP in California, lung cancer and mesothelioma in asbestos workers, Minimata Disease in Japan caused by methyl mercury in fish, and hepatomas in areas of the world where food was stored improperly and contained aflatoxins.

In developing countries, environmental epidemiology is mostly concerned with water and sanitation issues, including many diseases which, in developed countries, are considered to be infectious epidemiology.

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Epidemiologic research has two objectives in respect to these problems. The first one is to identify an excess frequency of the health event under discussion and to connect it with a possible cause. The second one is to investigate the possible health effects of exposure to a particular agent.

Since clusters can also occur by chance alone, epidemiologic research must determine whether the number of observed cases in a certain population is significantly higher than expected. This involves the usual epidemiologic methods of comparing the observed as against the expected number of cases in a population. In environmental issues, on the other hand, the determination of the population at risk poses specific problems, eg to decide who in the neighborhood of a hazardous waste site or a nuclear power plant is actually at risk. The situation becomes even more complicated when different levels of exposure are to be defined. Misclassification of exposure is a common occurrence. The definition of the outcome, ie a particular disease, also includes specific problems. Often the event is rare (leukemia), or non-specific (dizziness or rashes), or has a long latency period. Publicity might lead to an increase in reporting of the event in the affected area, as compared to the incidence in the general population.

The main difficulty in establishing a causal relationship between a hazard and a disease can be epitomized as two events occurring at the same time or place but not necessarily causally related, even if a statistically significant association exists between them.

It cannot be emphasized enough that surveys which ascertain both risk factors and suspected outcomes at the same time are consequently unable to establish a temporal relationship and, therefore, cannot determine a causality between the two events.

The same is true for ecologic studies. Comparing rates of disease and the occurrence of the suspected risk factors in different geographic areas can suggest associations, but they can never prove a causal relationship. Case control and prospective cohort studies are needed to establish temporality. This is often time consuming and expensive. Due to the rarity of some diseases, the studies have to be very extensive in order to discover a significant relationship. For example, to find a threefold increase in a disease which has a background inci-

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physical examination, complete blood count, chest roentgenogram and possibly exercise pulmonary function testing for hypoxic and hypercapneic drives.

g. Because of possible effects of hypoxemia on the fetus, if you are pregnant you should not ascend above 3,000 meters.

h. If you become ill at modest altitudes, a complete appraisal should be done at that point and further exposure to higher altitudes limited.

## Conclusion

Rapid exposure to moderate (3,000 meters) and high (5,000 meters) altitudes is uncomfortable for most people and life-threatening for some. With a knowledge of the physiologic principles of adaptation to high altitude and understanding of the signs and symptoms of diseases associated with such exposure, the physician and the traveler will be able to prevent both serious illness and death.

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State of Hawaii. In order to achieve these key health objectives, a large number of occupational-health professionals will be needed. The University of Hawaii School of Public Health expects to play an important role in their training.

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dence of 1 in 1,000, a study population of 10,000 is required. The risk of having any cancer per year is 3-4 per 1,000 population. The incidence of having a particular cancer is much lower and the study group required must be much larger.

Other criteria for causality have to be considered, especially biologic plausibility. Toxicologic data from studies of cell cultures or in animals often supply information which cannot be duplicated in human studies because it is impossible to expose the latter to experimental doses of toxic agents. Caution is advised, therefore, when so-called plausibility is used as a substitute for detailed information.

What seems "reasonable" in regards to causality is not necessarily true. Even though environmental epidemiology has made very valuable contributions to our knowledge of environmental hazards, the results reported in every study should be critically evaluated, keeping in mind the difficulties inherent in their methodology.

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